Section 4

Northern New Mexico Math and Science Academy

Northern New Mexico Math and Science Academy

Program Description. Student test scores and teacher competency surveys reveal a great need for improving teacher quality and student achievement in northern New Mexico. To meet this need, the Northern New Mexico Council on Excellence in Education (NNMCEE, a consortium of educational leaders from across northern New Mexico) developed the Math and Science Academy (MSA, the Academy) with support from three local school districts (Mora, Chama, and Española), the Northern Network for Rural Education, the University of California, and Los Alamos National Laboratory (LANL, the Laboratory). The development of the Academy was a "good neighbor" initiative on the part of the Laboratory in response to needs stated by NNMCEE. Fiscal year 2002 (FY02) was the second year of operation for the program.

The program focuses on middle-school, core-area teachers in northern New Mexico (Chama Middle School, Española Middle School, and Mora Middle School) for two reasons: First, the developers of the program believe that high-quality, middle-school teachers are essential to the future success of students because these teachers can affect attitudes toward education and the attainment of academic success at a critical time in the students' careers. Second, the organizers believe that targeting middle schools will help to decrease the dropout rate for ninth graders.

MSA seeks to use master teachers to improve education by sharing research-based best practices with colleagues. As teachers become more effective and understand standards-based instruction better, they will become the catalysts for systemic reform in their schools. The increase in teacher quality will then lead to improved student achievement. Once trained in this approach, MSA teachers will serve as mentors to other teachers in their schools.

MSA serves five groups: school districts, administrators, teachers, students, and the Laboratory. Each of these groups receives a specific set of services from the Academy, and, in turn, each group bears certain responsibilities for the success of a portion of the program. Figure 65 shows the program framework.

MSA serves school districts by helping them to meet their Educational Plan for Student Success goals (required by the New Mexico Department of Education). These goals, written by each school district, call for increased student achievement in one area or more. A focused, coherent, sustained professional-development program such as MSA is one way to meet this goal, and, in addition, provides a framework and impetus for systemic reform. The districts are responsible for providing stipends, travel funds, and technology for teachers from their schools who are participating. The districts also must provide office space for MSA.

MSA serves administrators (principals and assistant principals) by providing training on educational leadership qualities, standards-based education, and other MSA values during the Leadership Institute. In addition, the Leadership Institute gives administrators time to collaborate with other administrators. MSA encourages collaboration between administrators and teachers, thus promoting an understanding of MSA principles that leads to unity among staff members. The Master Teachers provide in-service training for MSA and non-MSA staff members at the request of administrators. MSA provides administrators with current literature on educational issues and research. Administrators are responsible for

TEACHERS

MSA Provides:

- Teacher Quality Institute
- Cognitive Coaching
- Supplies
- Content Training

Teachers Must Provide:

- Collaboration
- Portfolios
- Integration of Lessons
- Technology Integration
- Curriculum Planning

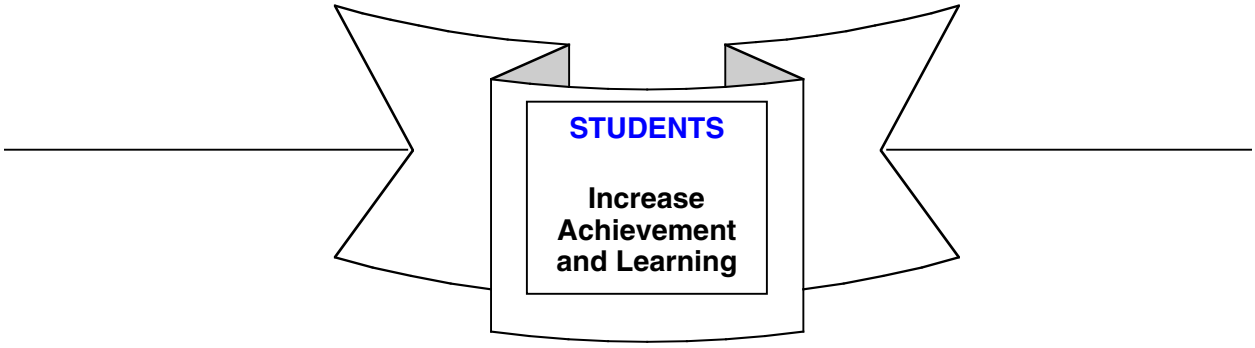
ADMINISTRATORS

MSA Provides:

- Leadership Institute
- Collaboration with Other Administrators and Teachers
- In-Service Training
- Current Literature and Research

Administrators Must Provide:

- Professional Development Plans as Necessary
- Informal Observations



SCHOOL DISTRICTS

MSA Provides:

- Help To Meet EPSS (Education Plan for Student Success) Goals
- Professional Development for Staff
- Liaison with SDE (State Department of Education)
- Framework and Impetus for Systemic Reform

School Districts Must Provide:

- Stipends for Teachers
- Travel Funds for MSA
- Technology for Teachers
- Office Space and Support

LANL

MSA Provides:

- Good Neighbor Initiative
- Community Outreach
- Increased Pool of Qualified Workers

LANL Must Provide:

- Salaries and Benefits for Master Teachers (MTs)
- Travel Funds for Site Visits and Professional Development for MTs
- Supervision and Oversight for MSA
- Program Funding
- Legislature Liaison
- Supplies and Technical Support
- NNMCEE

Figure 65. The program framework.

working with teachers to meet goals—including the writing of Professional Development Plans as necessary. Administrators support accountability for implementation of MSA principles by conducting informal observations in classrooms.

MSA serves teachers by providing intense, ongoing professional development through one-on-one, cognitive, monthly coaching sessions; feedback from informal observations; training once a month during after-school meetings; weekly meetings with colleagues; day-long training once a semester; content-area training; and the provision of classroom supplies not ordinarily provided by the school district. Teachers are responsible for collaborating with their teammates, keeping growth portfolios, reflecting on their practice, integrating instruction, integrating technology, implementing alternative assessment strategies, keeping and analyzing data, and doing curriculum planning. MSA responsibilities, including training time, require 200 hours over contract. The bulk of the training happens during the Summer Institute. Table 24 shows teacher demographics information.

MSA serves students by training their teachers to be prepared, confident, and effective in the classroom. MSA teachers offer students consistency, integration of lessons across the curriculum, and a list of key concepts and learning targets aligned to the New Mexico Content Standards. Students are taught to work together in cooperative learning groups, to chart their own achievement, to understand what it means to work toward a standard, and to demonstrate their understanding of concepts. In addition, students have the opportunity to engage in hands-on, minds-on activities in mathematics and science that are designed to enhance and reinforce learning. Reina Pacheco demonstrates "Volume" in Figure 66.

Table 24. Year 2 MSA Teacher Demographic Information

Variable	Descriptor	n=17
Sex	Male	5
	Female	12
Ethnicity	White	4
	Hispanic/Latino/Spanish American	11
	Native American	1
	Other	1
Highest Degree Received	Bachelor's Degree	2
	Bachelor's + Credential + Units Beyond	10
	Master's + Units Beyond	5
Teaching Credential(s)*	General Elementary	9
	General Secondary	8
	Special Emergency	0
	Multiple Subject	4
	Single Subject	1
	Bilingual	5
	Other: (Language Arts, Special Education, Early Childhood Education)	5
Years of Experience	Average Number	13 years
	Range	1 to 30 years
Previous Participant in Projects like MSA?	Yes	3

*Note: Teachers may hold multiple credentials.

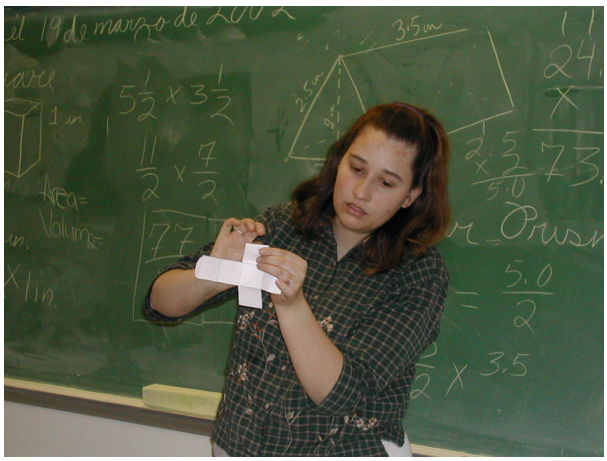


Figure 66. Reina Pacheco demonstrates "Volume."

MSA serves LANL by providing community educational outreach to participating schools. Students who achieve at a higher level will eventually increase the pool of highly qualified local talent for the Laboratory. The Laboratory, in turn, provides supervision, oversight, direction, accountability, salaries and benefits, and travel funds. It also serves as an advocate seeking operational funding for MSA.

Performance Goal, Objectives, and Milestones. MSA's programmatic goal is to improve math and science education significantly and initiate systemic reform grounded in standards-based education through intense, ongoing professional development and classroom follow-up that increases both content and pedagogical knowledge.

The initial performance objective for MSA is sustained change in teacher practice that focuses on and supports standards-based education. The ultimate objective is an increase in student achievement in math, science, and technology application.

MSA is a unique program because of the follow-up and continuing support that occur during the school year after the intense training during the summer. Not only are the professional developers on-site and in the classrooms at least once a month, but they are available to help the teachers plan and implement new strategies.

The National Center for Research on Evaluation, Standards, and Student Testing (CRESST) report on the second year of the MSA project commented on the unique design of the professional development delivered by MSA. It noted that in a survey, teachers were asked to evaluate their "overall change in instructional planning, articulation, and collaboration with colleagues as a result of MSA participation." In their responses, the teachers rated the program highly, saying that they had experienced "moderate to strong change" as a result of MSA participation.

The report went on to say that MSA's approach to professional development offers "multiple and varied opportunities for teachers to build their professional knowledge and expertise…." The report also noted, "…It means something to teachers be an MSA member, both personally and professionally."

The report quoted an MSA teacher as saying, "This is one of the most positive professional development experiences I've ever had. I'm a veteran teacher, and I've participated in many, many, many staff-development projects. But none of them have done for me what MSA has accomplished: rejuvenated my sense of wonder in teaching and learning. I'm trying new ideas. I'm thinking about things in dramatically different ways. There are so many reasons why this project works…. One of the primary reasons is that we're treated like professionals. People are doing important work. Another reason I think MSA is what it is rests on the fact that we've really developed as colleagues. I think of my MSA colleagues as family. Sometimes they make me mad; sometimes I feel irritated; but I treasure and value all the knowledge and ideas in MSA."

The accountability that must develop for the program to succeed is strengthened by the participation of the principals during informal observations. All concerned partners are looking closely at the students' standardized test scores, an indicator of their level of achievement. However, there are many other indicators along the way that can assist participants in assessing the effectiveness of any professional development program.

The Change Process. Robby Champion, who holds a doctorate in education, says, "All professional development programs need to be evaluated for their impact, but not necessarily all at the same time, nor all with the same intensity, nor using the same kind of data."

In order to understand the role of professional development in the change process, it is important to understand the stages of the change process. The line in Figure 67 represents the phases of the change process and also corresponds to the general feelings of the people involved.

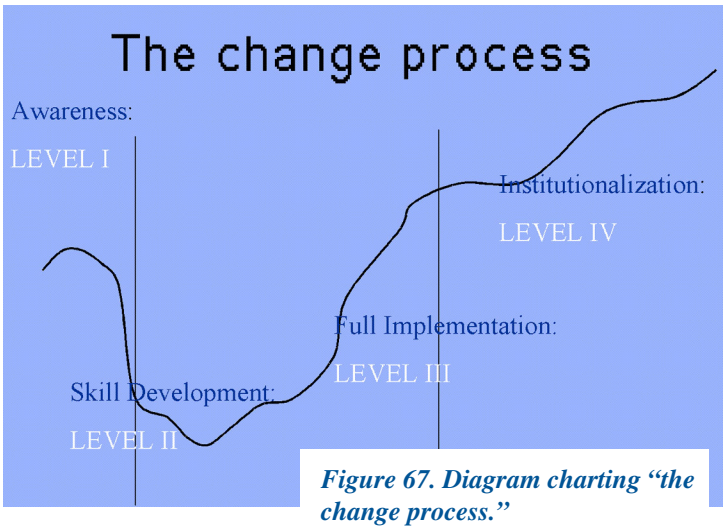


Figure 67. Diagram charting "the change process."

At first, there is resistance to change and a corresponding drop in the feelings of the people being asked to change. Then, as participants in the program start implementing new skills and strategies and begin seeing results, their feelings improve.

There is a definite difference in attitude, understanding, and implementation of MSA principles between the first-year participants and the second-year participants, but even within these groups, there are variations in implementation. Each teacher is at a different point in professional development and is moving at an individual rate. Table 25 shows the distribution of the teachers in the program.

Table 25. Chart of the Development of MSA Teachers in School Years 2000–2001, 2001–2002, and 2002–2003

2000–2001	**1st Year MSA**		
Teachers	12		
Total Participants	12		
2001–2002	**1st Year MSA**	**2nd Year MSA**	
Teachers	12	10	
Teachers New to District or Grade Level	(5) already included in above number		
Student Teachers	3		
Total Participants	25		
2002-2003	**1st Year MSA**	**2nd Year MSA**	**3rd Year MSA**
Teachers	3	9	10
Teachers New to District or Grade Level	(2) already included in above number		
First-Year Teachers (MSA Student Teachers 2001-2002)		2	
Total Participants	24		

The CRESST report noted the difference between first- and second-year teachers in its assessment of the effectiveness of MSA (see Table 26). The report said:

> *"In general, teachers, students, administrators and mentors were positive about Year 2 (2002) of MSA. Classroom observations, interviews, and survey results provide data to support these conclusions. Teachers were asked to rate MSA's overall effectiveness in a number of areas. These survey results are displayed in the table below. Notice that while the overall ratings were moderately positive, Year 2 MSA teachers rated all survey items more positively than did Year 1 (2001) MSA teachers. Statistically significant differences are noted on a number of the subscales."*

Indicators of Impact. The first level of impact in professional development is awareness. This level is the initiation stage and corresponds to the developmental year for MSA. The second level of impact is skill development. This level produces sporadic implementation and incorporates practice with feedback. The participants who are monitored may feel discouraged, confused, and frustrated by the changes they are asked to implement. The third level of impact is full implementation. This level results in regular use of the new skills. As participants become more familiar with the new strategies and see the results of changes, they feel better about their performance and the change process. The fourth and final level of impact is institutionalization. In education, this level means that the whole school is implementing the changes. It is at level IV that the school reaches the ultimate goal, increased student achievement.

Table 26. MSA Effectiveness (SD = Standard Deviation)

How effective was MSA in the following areas?	Overall 2001–2002 Mean (SD) N = 17	Year 1 MSA Teachers Mean (SD) N = 7	Year 2 MSA Teachers Mean (SD) N = 9
Familiarizing you with standards-based instruction	4.5 (0.6)	4.5 (0.5)	4.5 (0.8)
Developing your knowledge of state frameworks for content areas	4.2 (0.7)	4.1 (0.4)	4.2 (0.8)
Helping you develop interdisciplinary curriculum units	3.6** (1.2)	2.7** (1.3)	4.2** (0.7)
Providing demonstration lessons that were meaningful and relevant to you and your students	3.6** (1.0)	2.7** (0.9)	4.2** (0.4)
Sharing assessment strategies	3.9* (0.9)	3.5* (0.8)	4.4* (0.7)
Informing/involving the community about MSA goals and objectives	3.4* (1.4)	2.3** (1.3)	4.3** (0.7)
Helping you understand how to use technology effectively	3.7* (1.2)	2.7* (1.1)	4.4* (0.5)
Assisting you in implementing cooperative learning activities	3.5 (0.9)	3.0 (0.9)	3.9 (0.8)

Note: Scale: 1 = Not Effective; 3 = Somewhat Effective; 5 = Highly Effective.
*Statistically significant at the ($p < 0.05$) level.
**Statistically significant at the ($p < 0.01$) level.

During 2002, there were 22 teachers and three preservice teachers participating in MSA. Ten of the teachers were second-year participants. The rest were first-year participants. Some MSA teachers were close to level III, while others were at level II. Two or three were still at level I.

As we begin FY03, there are three participants new to MSA, all at one site in Española. Two of the student teachers who participated in the program last year have been hired by their respective districts and will start their teaching careers as second-year MSA teachers.

Indicators of Impact for the MSA Program. MSA tries to answer the following questions to monitor impact:

- Does teacher practice incorporate at least three elements from training? (level II-III)
- Do teachers collaborate to deliver crosscurricular units? (level III)
- Do teachers use technology to deliver the curriculum? (level II-III)
- Do teachers and students know and articulate expectations such as learning goals for each lesson, unit, nine-week period, semester, and year? (level III)
- Do students use technology to present what they learned? (level III)
- Does student attendance improve? (level IV)
- Do student grades and scores on standardized tests improve? (level IV)

Sources of Data. The data sources for the indicators of impact are shown in the following list:

- meeting notes (monthly, level II);
- formal observations (monthly, level II-III);
- informal observations (monthly, level II-III);
- the Instructional Practice Inventory (yearly, level II-III);
- exit interviews with teachers (yearly, level II–III);
- exit interviews with principals (yearly, level II–III);
- curriculum maps (yearly, level III);
- achievement charts (monthly, level III);
- teacher/student portfolios (monthly, level III);
- attendance (yearly, level IV);
- student grades (semester, level IV); and
- scores on the Comprehensive Test of Basic Skills (yearly, level IV)

Data are taken monthly, at the end of the semester, and yearly. Data are analyzed yearly, and a report of progress is written annually. Table 27 presents the data sources and indicators.

A Brief Assessment. The CRESST report summarized the scores of MSA students on the Statewide Student Achievement Assessment in the following remarks:

"…Another source of data on project success was student achievement scores for MSA students on the Statewide Student Achievement Assessment mandated by the State Board of Education. Data were collected from all four sites for MSA students for the 2001–2002 school year. This year, a new version of the CTB was administered statewide. The publishing company, McGraw-Hill, has released limited technical data on the reliability and validity of comparing this year's scores to previous years (using a different measure). Statewide in New Mexico, school districts expressed concern over a decline in the 2001–2002 test scores. In Los Alamos, for example, a 10% decline in all scores was reported from last year to this year. Technical issues create problematic situations for districts and projects like MSA alike; for schools, funding is based on improvement, and to a certain extent, continued funding of MSA is also contingent upon showing increases in student learning. This situation becomes challenging when one of the primary instruments used to gauge learning changes from year to year."

Table 27. Indicators/Data Source Matrix

Question/ Indicators of Impact	Meeting Notes	Formal Observations	Informal Observations	Instructional Practice Inventory	Exit Interviews with Teachers	Exit Interviews with Principals	Curriculum Maps	Achievement Charts	Teacher/ Student Portfolios	Attendance	Student Grades	CTBS Scores
Does teacher practice incorporate at least three elements from training (curriculum, e.g., concepts and questions; instructional strategies, e.g., cooperative learning, graphic organizers; assessment techniques, e.g., rubrics, portfolios, performance assessments, student self-assessment) on a regular basis?		✓	✓		✓		✓	✓	✓			
Do teachers on teams plan and implement at least one integrated unit per semester?	✓	✓		✓	✓	✓	✓		✓			
Do teachers use technology at least weekly to deliver curriculum?		✓	✓	✓	✓	✓			✓			
Are class expectations for learning written or discussed at every lesson?		✓	✓	✓	✓	✓						
Do students use technology to show what they have learned at least once a month?		✓	✓	✓	✓	✓			✓			
Is student attendance between 90%–100%?					✓	✓				✓		
Do student grades improve overall?					✓	✓		✓			✓	
Do student scores on the CTBS show a trend of moving from the first and second quartiles into the third and fourth quartiles?												✓

"That caveat stated, we made a comparison between student scores for the past three years, based on Normal Curve Equivalent Scores (NCEs). NCEs convert percentile scores to equal interval scales to allow for computation of means and standard deviations. Scores are reported for language arts, reading, math, science, and social studies. As in Year 1 of the project, all students participated in the project, thus no non-MSA students or comparison data were available. Data were available for eighth-grade students at School D, representing a subset of last year's MSA students from School A. For School A, only one year of data is represented (2002 test results). Three years of data are displayed for School B; that is, test scores are available for the same group of students during their sixth-, seventh-, and eighth-grade years. For the majority of seventh-grade students at all three sites, there were no statistically significant increases in NCEs from sixth to seventh grade. Some of the specific topics showed slight increases. At School X, math and science scores have shown a slight increase over the past three years."

See Tables 28 through 31 for scores from Schools A, B, C, and D.

Highlights of This Year's Accomplishments.

Integration of Lessons Across the Curriculum. Teachers at each site developed and implemented integrated units that fit naturally into their curriculum this year.

Chama Middle School had particular success with the math-science integration. Some data from the science curriculum were used to learn how to make pie charts. The math and science teachers

Table 28. School A MSA CTBS/NCE Scores (n=360)

Grade	Reading	Language Arts	Math	Science	Social Studies
7th	43	46	38	39	38

Table 29. School B MSA CTBS/NCE Scores (n=20)

Grade	Reading	Language Arts	Math	Science	Social Studies
6th	52	50	49	54	51
7th	49	52	47	52	53
8th	54	51	49	53	50

Table 30. School C MSA CTBS/NCE Scores (Grade 6: n=54, Grade 7: n=72, Grade 8: n=54)

Year and Grade	Reading	Language Arts	Math	Science	Social Studies
2002/6th	43	45	40	43	44
2002/7th	44	45	41	39	40
2002/8th	47	45	46	44	43

Table 31. School D MSA CTBS/NCE Scores, Eighth Grade

Year and Grade	Reading	Language Arts	Math	Science	Social Studies
2000/6th	36	42	39	39	40
2001/7th	39	41	34	40	40
2002/8th	43	42	38	42	38

team taught, and the students were very positive about their experience. One student expressed it this way: "Why can't we learn this way all the time?"

During the first semester, Mora Middle School teachers designed a measurement unit that had all four core areas involved in measuring, recording, mapping, and writing about the dimensions of the school. During the second semester, the science and language arts teachers implemented an integrated unit on biomes that culminated in a creative book project. In science, the students did research about biomes and an animal in a certain biome. In language arts, they worked on the technical aspects of writing a story for an elementary-school audience. After the students wrote their stories, they constructed books with pictures and practiced reading a picture book to children. Finally, they went to several elementary-school classrooms and read their books to real audiences. An end-of-year unit that integrated science and language arts again involved a field trip for a study of riparian ecosystem, soils, macroinvertebrates, and poetry writing. The students learned about the water creatures first in class with the help of a presenter from La Jicarita Enterprise Community who brought many samples. The field trip to Coyote Creek involved teachers and parents as well as the presenter.

The Española seventh-grade science and social studies teachers spent the last nine weeks of the year on an integrated unit on water. In science, the students participated in many activities involving water conservation, pollution, audits, etc. In social studies, the focus was on acequias and how the history and current use of these historic canals impact the lives of people in northern New Mexico. There were guest speakers and films in both content areas that enriched the experience for the students. As a culminating activity, students went on a field trip that included a visit to the Alcalde Agricultural Center, a macroinvertebrate study on the Rio Grande, and a presentation about the bosque (riverside forest) in Alcalde. The students learned about the scientific method at the agricultural center, which is run by the New Mexico State University Cooperative Extension Service. They also listened to a talk about the acequias. At the river, Jamie Brytowski, from the New Mexico Department of Game and Fish, led the students in a study of the macroinvertebrates that they had collected. The presentation about the bosque helped students understand the impact that people have had on the river and the surrounding area. A sack lunch at the Oñate Center topped off an incredible day (see Figures 68 through 70).

Technology. MSA teachers were required to participate in an on-line group. They were given a topic each week and asked to reflect on the topic and reply to the group.

Chama and Mora Middle School teachers were enthusiastic about the technology they could integrate into their lessons. Students at both sites were excited to learn PowerPoint and soon became adept in using it. Teachers became more comfortable using technology, and, although being pushed to participate in the on-line group was frustrating to some, it was enjoyable to most.

Teachers in Española struggled for yet another year waiting for the district to provide computers and training. However, by the end of school year 2001–2002, the Technology Department had provided all MSA teachers with laptops.

Figure 68. Boys gather macroinvertebrates in the Rio Grande.

Figure 69. These children are learning about the bosque.

Figure 70. A sack lunch at the Oñate Center capped a wonderful field trip.

The new laptops were made available and used by MSA teachers during Summer Institute 2002.

The teachers in Chama were able to use the technology money set aside for distance education to purchase laptops for three of the team members. The Bilingual Program provided a fourth. As a result, all of the Chama team members had laptops for Summer Institute 2002.

The Mora team is currently using MSA laptops. Mora used funds raised through a Technology Literacy Challenge Fund grant written with help from the MSA grant writer, Carlos Romero, to purchase a mobile laptop laboratory with 30 units that have wireless connections to the Internet and wireless connections to a printer. This laboratory has become the envy of the teachers in all MSA districts (see Figure 71).

Figure 71. The mobile laptop laboratory in Mora.

MSA teachers in Española did not have a computer laboratory at their schools during 2002, but computer labs are now installed at all sites.

It was exciting to see all the teachers using their laptops for planning and reflection—not with a sense of dread or punishment, but with enthusiasm. All teachers are now comfortable with this technology, and all of them intend to use it in their classrooms (see Figure 72).

Student Teachers. A new component of MSA in 2002 was the addition of student teachers to the cadre of MSA teachers. This initiative, funded

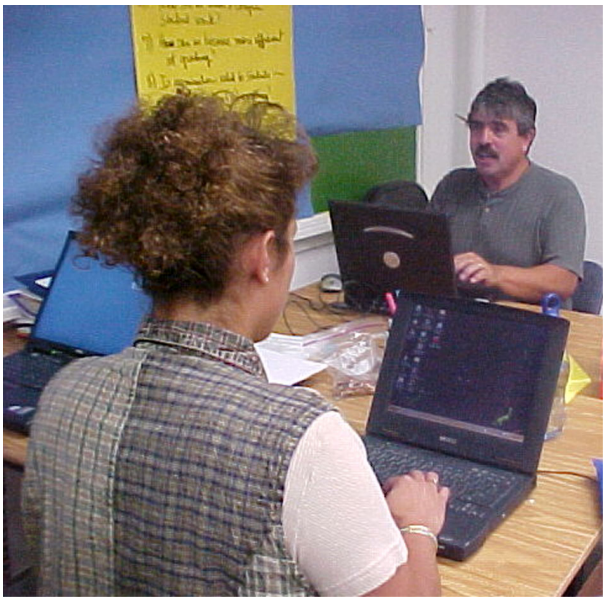


Figure 72. Teachers use laptops during the MSA Summer Institute.

through the New Mexico Commission on Higher Education, allowed MSA to mentor three student teachers: Ann Peterson, who worked with Paige Prescott at Española Middle School East; Reina Pacheco, who worked with Evelyn Sanchez at Mora Middle School; and Denise Gallegos, who worked with the team at Chama Middle School. Peterson and Pacheco both completed the requirements for obtaining licensure. Peterson is now teaching science at Española Middle School East, and Pacheco is a math teacher at Mora High School. Both attended Summer Institute 2002 and are participating members of MSA for the school year 2002–2003. Both teachers will be receiving regular MSA visits and support during their first year in the classroom. Gallegos is still working on her credentials, and the team in Chama has agreed to assist her although she is not an MSA teacher this year.

Elliot Asp, Featured Speaker at the Leadership Institute. Standards-based education was one of the topics for administrators during the 2002 Leadership Institute. LANL and MSA cosponsored Elliot Asp, associate superintendent of the Douglas County Schools in Colorado, as the Institute speaker, discussing the implementation of standards-based education. Members of the

educational community were invited to attend. The audience included faculty members from Northern New Mexico Community College, staff members of the New Mexico State Department of Education, teachers, administrators, and faculty members and students from the teacher-preparation program at the College of Santa Fe.

NNMCEE Visits. Members of NNMCEE, the organization that envisioned MSA, scheduled three on-site monthly meetings at the schools served by MSA. These meetings gave NNMCEE members first-hand experience with the work of MSA and an opportunity to speak with teachers and students. After the visits, administrators and teachers met with NNMCEE members to discuss program goals and achievements (see Figure 73).

Figure 73. The Española school superintendent visits classrooms with other NNMCEE participants.